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USING CAI TO TEACH VOCABULARY CONCEPTS.(U)
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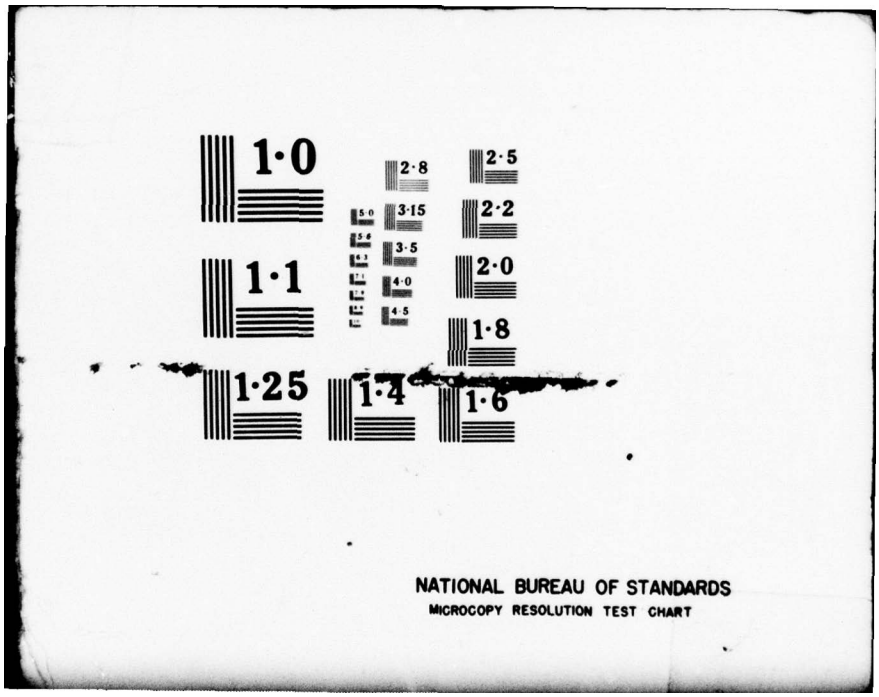
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Work is currently in progress to develop computer-assisted instructional materials to teach new vocabulary words to college students. Seven different instructional strategies are being developed to teach the new words, each strategy targeted toward a different learning outcome. Paralleling the development objective is a research objective to assess the effectiveness of each strategy and to determine which strategies best promote transfer.

Current design theories state that different instructional conditions are needed for different types of learned performances. In contrast, a 1966 research study that taught vocabulary concepts to college students through four methods showed that students learning by one method also did quite well on tests matched to the other methods. We hope to demonstrate through our own research and development effort that the all-strategies prescription of design theory is excessive and that it is possible to achieve acceptable levels of performance on all seven criterion tests using fewer than the complete set of strategies available.

The remainder of the paper discusses the general rationale and design of the seven instructional strategies and then elaborates upon the design of three strategies, DEFINE, WORD RELATIONS, and CLASSIFY, by illustrating the teaching sequences using a sample word from the instructional database.

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Using CAI to Teach Vocabulary Concepts[1]

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Using CAI to Teach Vocabulary Concepts

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Overview

The work that is described in this paper is currently in progress at the Learning Research and Development Center at the University of Pittsburgh. The objective of our project is the development of computer-assisted instructional materials to teach new vocabulary words to college students. We are developing seven different instructional strategies to teach the new words. Our research objective is to assess the effectiveness of each strategy and to determine which strategies promote transfer. From the findings of our research we hope to be able to develop prescriptions for teaching vocabulary that are both effective and efficient, as shown through empirical tests.

We begin by first recognizing that competence with a particular word means that the student can do a variety of things with it: s/he can tell you what it means, use it in a sentence, differentiate it from other words, etc. There are, in effect, a variety of behaviors that reflect "knowing" the meaning of a word. An instructional program designed to teach word knowledge ought to build each of these behaviors. The question that we therefore

must address is how to design instruction to produce these different learning outcomes in the most effective and in the most efficient manner.

Prescriptions from design theory

Design theories such as those developed by Gagné (1977); Gagné and Briggs (1974); Klausmeier, Ghatala, & Frayer (1974); and Merrill & Wood (1975), state that different instructional conditions are needed for different types of learning content and/or for different types of learning skills. When our individual vocabulary objectives are analyzed in terms of existing typologies, we find that we are in fact working with different types of learned performances. Taking another tact, we can apply Merrill and Wood's system for effective instructional strategy design to determine what it would prescribe for our vocabulary design problem. Working through the Merrill and Wood system (see Block & McCaslin 1978 for an extended discussion of the logic of applying the Merrill and Wood system) led us to conclude again that we are indeed dealing with different types of learned behaviors. Since different instructional conditions are required for different types of learning outcomes, as developers, we will need to design an instructional strategy for each learning outcome. And, these strategies should be designed so they specifically teach toward each outcome. For the design problem we face, a one-to-one matching rule is in effect: for each terminal objective, design

theories tell us there is to be an instructional procedure matched to it. If we have n learning outcomes, we need n instructional strategies, according to design theory at least. To build each outcome performance in the student, each student will need to experience each instructional strategy. The instructional prescription from design theory is indeed quite clear.

It is pertinent here to note, however, that design theories have been formulated to allow the development of instructional prescriptions that are more or less "guaranteed" effective. But these prescriptions are not necessarily efficient and our vocabulary prescription is a good case in point. With our rule that there must be one strategy for each outcome, students will need to receive instruction through all strategies, if all behaviors are to be built. Anyone concerned with instructional costs and the use of learner time will immediately see that this prescription is an "expensive" one. To cut back on it, we would need to be able to believe in the possibility of transfer, that is, that instruction by one strategy builds more than a single outcome. Let us examine this notion more closely by considering the hypothetical empirical basis for the expensive, all-strategies prescription.

Empirical evidence and instructional prescriptions

Figure 1 presents the hypothetical results of an experiment evaluating four methods of vocabulary instruction. The x-axis

represents four different outcome measures; the y-axis the probability of correct performance on the measures. As shown at the upper left, designers would hypothesize that training by Instructional Procedure 1 would show best results on Outcome Measure 1, the measure directly addressed by the training procedure. Performance on other outcome measures by a subject trained through Procedure 1 would presumably be substantially poorer. Similarly, Instructional Procedure 2 would produce good results on Outcome 2, Instructional Procedure 3 on Outcome 3, etc. The graphs portray the results on which an all-strategies prescription is based. They portray a characteristic peaking of achievement at the outcome that is the target of the instructional strategy.

However, in direct conflict with a design theory prediction are a set of actual results obtained in a study by Johnson and Stratton (1966). In the Johnson and Stratton study, undergraduate psychology students learned four vocabulary concepts by one of five teaching methods. Four of the five teaching methods were designed so they would directly teach toward one of four different learning outcomes. The four teaching methods were: definitions, sentences, classification, and synonyms. There were four tests measuring the outcomes. Each test required a different behavior: a definition statement, a completion of a sentence, a classification of examples, and a synonym selection. Instruction was done with paper and pencil materials. The four individual instructional methods were designed to be as distinct from one another as

possible - the stimuli presented and the types of responses required of subjects were different among the four methods. After instruction by one method, students took both the test matched to that method and the other three tests. In this way, both direct instructional effects (effects of method i on test i) and indirect effects (effects of method i on test j) were assessed. Johnson and Stratton's results for the four individual methods are displayed in Figure 2.

As can be seen by Figure 2, results of the Johnson and Stratton study do not show peaking on the learning outcome matched to the instructional method. That is, there are no direct instructional effects. Even further, there are sizeable indirect effects. That is, students learning by one method also did quite well on tests matched to the other methods; apparently, learning by one method transferred to tests based on the other methods. Overall, the pattern of the Johnson and Stratton results appears the same despite the instructional method used. That is, the pattern of effects appears quite independent of instructional method.[3]

Discussion of the apparent contradiction

If we compare the state of the world assumed by design theory to the findings of Johnson and Stratton, there is a clear

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[3]Statements we have made here are verified by the statistical tests that Johnson and Stratton performed.

discrepancy which must be resolved to permit development decisions. Basically, we believe the weight of the evidence is on the side of design theory for two reasons. First, design theory itself is developed from a broad base of empirical findings at the heart of which is a principle of training-to-test transfer. Second, we believe that the Johnson and Stratton training procedure did not exert sufficient control over student learning processes; so that it was not a well instrumented test of the effects of various instructional methods.

Findings from transfer research have culminated in the principle that training to test transfer is enhanced to the extent that properties of the training are similar to the properties of the test. The Johnson and Stratton methods and test were quite similar but their results clearly contradict this principle of transfer. For methodological reasons, however, we do not believe their data represent a serious challenge. Johnson and Stratton found no direct effects, and despite large differences among their instructional procedures the patterns of results are quite similar. Thus, it is quite possible that the independent variable was not even implemented. That is, the degree of control over student learning processes possible with paper and pencil materials was insufficient to produce the direct effects that may really be there, and that the weight of empirical evidence suggests are there. With more stringent control over instructional processes, direct effects may well appear. Use of a computer with lessons in a CAI mode permits this more precise

control. Based on these considerations, for the development context in which we work, it seems most appropriate to develop a strategy for each learning outcome.

It would trivialize the importance of our research to simply dismiss the Johnson and Stratton results on a methodological point. Consider what these results mean if they are in fact real and generalizable to our situation using a computer. They would indicate sharp disconfirmation of design theory in our situation, which in turn indicates that design theory may not be a general theory but rather is subject matter specific. Secondly, to the extent that particular strategies produce indirect effects, all strategies would not be needed, thus there would be significant gains in instructional efficiency. What we have decided to do is attempt to build individual strategies so that they are targeted toward a particular outcome (that is, they produce direct effects) but also so they permit the achievement of indirect effects that are practically significant. Our attitude toward what we can accomplish instructionally reflects on what we think the state of the world is empirically. We believe that the actual state of the world is somewhere in between the strong peaking presumed by design theory and the absence of peaking obtained in the Johnson and Stratton research.

In another paper (see Block & McCaslin, 1978) we have developed a quantitative model that helps us to choose instructional methods to maximize certain performance criteria. If we have a

numerical estimate of the size of the direct effects and a numerical estimate of the size of the indirect effects that are associated with a given method, and we have mathematical functions describing how the effects combine when methods are used together, we can select combinations of methods to help us achieve certain specific ends. Time restrictions do not permit our discussing the model here. We do hope, though, that through more precise formulations of instructional design questions and the conduct of co-ordinate empirical tests, we can refine design theory and become able to make specific instructional suggestions to teachers to help them guide student learning more efficiently.

To summarize, what we would like to be able to demonstrate through our development work is that the all-strategies prescription of design theory is incorrect and that it is possible to achieve acceptable levels of performance on all criterion tests using fewer than the complete set of strategies available. If this result can be achieved, some smaller combination of teaching modules than the full set should produce acceptable levels of performance on the outcome measures, at a lower cost in instructional time (i.e., lower compared to a prescription that requires all strategies to be given). That is, three or four modules may do the job of seven. The purpose of our research is to attempt to produce the outcomes we desire and then to revise design theory if need be. We must develop, implement, and evaluate the vocabulary

instruction we produce, instruction that will be presented to college students via the computer. In the remainder of this presentation, we want to turn from a description of our conceptual framework and research objectives to a discussion of the rationale and design of our instructional modules.

The design of the vocabulary instructional strategies

The seven outcomes that represent our instructional goals are found in Figure 3. The word in parentheses following each outcome is the name we have given the instructional module that teaches toward that outcome. The design of our modules was shaped by what we hope to demonstrate; that is, we want to show that the modules can produce a direct effect, i.e., a peaking on their matched criterion test. But we also want to show evidence of indirect effects, i.e., that teaching via a particular module transfers to tests based on the other modules.

To obtain direct effects, we retained the response identity property between instruction ~ and - test used by Johnson and Stratton in their research. That is, a test requiring classification is taught toward by a method that requires students to classify, and so forth for the other methods and tests. This property, of course, is a condition enabling training to test transfer. To enhance the chances of indirect effects, we supplemented the information about word meaning contained in each method, over and above what Johnson and Stratton did.

In the Johnson and Stratton research, a "method" of instruction was defined in terms of the format of the stimulus and the particular kind of response. We analyzed the Johnson and Stratton methods to determine which stimuli were paired with which responses within each of their instructional methods. We discovered that Johnson and Stratton paired stimuli and responses in such a way that the content, or object, of the response was presented in the stimulus portion of the method. For example, the presentation of a definition as a stimulus was paired with a definition paraphrase as a response. In this type of methods design, subjects would not have to recode the information presented into another linguistic form (as they would have to if the stimulus were a definition and the response sentence construction). Following this procedure seemed entirely sensible to us since it maximizes the duration of the subject's exposure to instructional content in the form that it is to be learned. It also enables the designer to easily keep the different instructional methods distinct from one another, a condition which we believe is vital if we are to achieve direct instructional effects.

Other design guidelines came from the instructional prescriptions for concept teaching developed by Merrill and Tennyson (1977). These were extremely helpful to us in the design of one of our modules, CLASSIFY. Beyond the general suggestions taken from Johnson and Stratton and from Merrill and Tennyson, added details of the instructional strategies had to be specified.

Instructional strategies are comprised of smaller segments of instruction called routines and these routines were designed by following a shaping procedure, i.e., gradually reducing the stimulus support for the required terminal response as the lesson proceded. In another paper we have provided a more extensive rationale for the design decisions made in the course of specifying a module. We have had time only to sketch them here.

In the remaining time, we'll describe DEFINE, WORD RELATIONS, and CLASSIFY in some detail. WORDS IN CONTEXT, CREATE, WORD LINE, and EQUIVALENTS will just be sketched.

The content structure taught in the DEFINE module is the definition of a vocabulary word; the terminal response task of the module is to construct a definition paraphrase. Our computer lesson design segments the learning process into elementary events and through suitable design of the instructional routines, guides the learning process through a series of stages. We designed the module to accomplish several purposes - to call attention to the key elements of the definition content -- the critical attributes of the definition; to control the number of rehearsals or encounters with each critical attribute; and to institute a form of retrieval practice in which students must construct a definition from memory. The conceptual framework that rationalizes this instructional design is the Frase (1975) model of prose processing in which there is an attempt to relate instructional programming characteristics to the prose learning processes of rehearsal, relation, and retrieval.

The DEFINE module comprises seven exercise routines. As we describe the tasks in order by routine, you may want to refer to Figure 4, which presents simulated DECscope video terminal screen displays for the routines.

Routine 1: Pronounce. This is the first routine in all seven modules. The routine identifies the target word and provides a phonetic pronunciation key, with the direction to the subject to pronounce the word. The caret on the screen display alerts the subject to press the return key in order to proceed.

Routine 2: Definition. A definition of the target word is then presented, emphasizing its critical attributes by separating them visually from the rest of the display. For nouns, such as sycophant -- the concept used in the simulated screen display -- the definition assumes a genus et differentia form; that is, it places the target word in a higher order class and then characterizes it in a specific way. Definitions for verbs and adjectives use synonyms plus contextual information.

Routine 3: Type word from memory. In this routine, with the same display as in Routine 2 as a stimulus, the subject studies the target word until ready to type it from memory. Then, as a response, the subject types the word after the stimulus has been erased from the screen. Feedback here either confirms a correct response or re-presents the word, which is then retyped by the subject while the word remains on view.

Routine 4: Definition with attribute labeling. The form class (part of speech) of the target word is identified in this

routine with a general statement alerting the subject to the format that a definition of words of this form class should assume. Then the definition of the target word is presented again, this time with its critical attributes labeled.

Routine 5: Multiple choice paraphrase of each critical attribute of definition. Next, the subject receives a multiple choice exercise in which a partial definition paraphrased from the original presentation appears on the screen; the subject completes the definition by selecting the correct paraphrase of the critical attribute that is missing. Feedback for a correct response confirms the response and then fills the missing critical attribute into the definition. Feedback for an incorrect response tells the subject to try again. After two incorrect responses, the critical attribute is filled into the definition and the subject studies the definition before going on. This routine is repeated for the number of critical attributes contained in the target word. For sycophant, the routine would be repeated two more times while a paraphrase of each of the two other critical attributes is selected.

Routine 6: Multiple choice paraphrase of all critical attributes. In this routine, all critical attributes for the definition are selected and then typed by the subject within one exercise, not individually as in Routine 5. This routine, therefore, begins to approximate definition construction. The subject's responses and feedback are similar to those in Routine 5.

Routine 7: Definition construction. In the final routine of the module, the subject composes and types a definition of the target word. S/he is cued to use the target word in the definition and to phrase the definition to make it read appropriately for a word of its form class. After making the response, as feedback, the subject compares his or her definition with the original definition.

The criterion test for this module is definition construction. It is identical to the exercise in Routine 7, eliminating the feedback.

That's Module DEFINE; now let's look at WORD RELATIONS. Our WORD RELATIONS module is based upon an application of a process model for long term memory in which information is stored as semantic networks. In the Rumelhart, Lindsay, and Norman (1972) model, the network of concepts is interconnected by relations. Meanings are established through the relations that hold among various concepts. In our WORD RELATIONS modules, then, the target word is presented along with another word that is related in some way. The subject determines the relationship between the two words. Our module attempts to be a directed pathfinding strategy between the target word and other words that would likely be nearby nodes in the subject's memory representation. Figure 5 presents a simulated screen display for the WORD RELATIONS routines.

Routine 1: Pronounce. As mentioned previously, this is the first routine in all of our modules. Just as in DEFINE, the routine here identifies the target word and provides a phonetic pronunciation key, with the direction to the subject to pronounce the word.

Routine 2: Definition. Just as in DEFINE, a definition of the target word is then presented, emphasizing its critical attributes by separating them visually from the rest of the display.

Routine 3: Forced paraphrase. This routine represents an attempt to get a short paraphrase of the definition into the subject's working memory, since the definition of the target word will not be on view as the subject determines the relationships between words. Here, the subject selects the letter of the phrase that is closest in meaning to the target word. Feedback either confirms a correct response or instructs subjects with incorrect responses to reread the definition and then to answer the question again.

Routine 4: Type word from memory. Similar to a routine in DEFINE, with the target word as a stimulus, the subject studies the target word until ready to type it from memory. As a response, the subject types the word after the stimulus has been erased from the screen. Feedback here either confirms a correct response or re-presents the word, which is then retyped by the subject while the word remains on view.

Routine 5: Explanation of relations. At the beginning of this routine, a relation is established between the target word

and another word. After that, another word bearing the same relationship appears with the target word, and, as a response, the subject identifies the relationship by typing it in. Feedback for a correct response confirms the subject's answer. Feedback for an incorrect response identifies the correct relationship for the subject. In the final part of this routine, the sentence is rephrased as a question with multiple choice responses, and the subject selects the one response of the three that establishes the true relationship between the two words. Once again, feedback for a correct response confirms the answer; feedback for an incorrect response alerts the subject to try again. This routine is repeated for the number of relationships established for the target word. For sycophant, the relations to be used are: quality, goal, act, and target. The routine would be repeated as each of these relations is set up.

Routine 6: Practice relations. In this routine, the subject identifies the relationship between selected words and the target word. The relations are the same as those established in Routine 5; the words that form the relationships are different. Feedback confirms a correct response or identifies the correct relation in the case of an incorrect response. When an incorrect response has been given, the question is re-presented at the end of the series of questions. There are approximately 20 questions in this routine -- in the case of sycophant, five questions for each of the four relationships that have been established.

The criterion test for this module is identical to the task in Routine 6, eliminating feedback. Because this test is based upon a model of memory, we are considering it to be experimental in nature. It will be of great interest to us to determine whether a subject receiving instruction solely through the WORD RELATIONS module will reflect a difference in cognitive structure from those subjects receiving instruction through the other modules.

Now let's proceed to the CLASSIFY module. The rationale for CLASSIFY is based closely upon the design guidelines specified by Merrill and Tennyson (1977) for teaching concepts. CLASSIFY comprises five exercise routines. Figure 6 presents simulated screen displays for the CLASSIFY routines. Here we will dwell upon only those routines that are unique to CLASSIFY, *those not* contained in either DEFINE or WORD RELATIONS.

Routines 1 and 2 have been discussed previously.

Routine 3: Matched examples and nonexamples. Here, a situational example of the target word is presented, labeled as an EXAMPLE. The subject answers a yes-no question, focusing on one of the target word's critical attributes by typing a Y for a yes answer or an N for a no answer. Feedback after the response alerts the subject to the correct response and provides attribute isolation help; that is, the feedback assists the subject in encoding the example in terms of a critical attribute. A matched situational nonexample of the target word is then presented,

labeled as NOT AN EXAMPLE. The matched nonexample is visually paired on the screen with the example. The same yes-no question is presented along with the nonexample. Once again, feedback after the response alerts the subject to the correct response and provides attribute isolation help. This matched example/nonexample pairing with yes-no questions on a critical attribute is repeated for the number of critical attributes contained in the target word. For sycophant, Routine 3 would be repeated two more times.

Routine 4: Forced choice of example. Next, a matched example/nonexample pair of situations is presented; the subject is instructed that only one of the pair is an example of the target word. The subject identifies the number of the instance that is the example. *Feedback alerts the subject to the correct* response and identifies the specific wording in the example that "gives it away" as the example. The number of times that this routine is repeated is also dependent upon the number of critical attributes in the target word.

Routine 5: Classification. In the final routine of Module CLASSIFY, one instance at a time is presented to the subject, with the direction to identify the instance as an example or not as an example of the target word. This routine is repeated a varying number of times, depending upon the difficulty of the word being taught. For sycophant, ten instances are presented. Feedback for a correct response confirms the response as correct.

Feedback for an incorrect response constructs a matched example/nonexample pair out of the instance being presented and labels for the subject which instance of the pair is the EXAMPLE and which is NOT THE EXAMPLE.

The criterion test for this module is the classification task specified by Merrill and Tennyson; that is, when given the target word and shown representations of specific instances representing examples and nonexamples of the class, the subject identifies those situations that are members of the class and those that are not. The criterion test is the same as the exercise presented in Routine 5, using different instances and eliminating feedback.

Very briefly, in the WORDS IN CONTEXT module, the subject reads a short story containing the target word, and then completes a series of sentences by using the target word meaningfully. It currently seems necessary to have the sentence fragments in the response task end with the word <u>because</u> in order to assure that the target word is used meaningfully.

Module CREATE is targeted toward example construction. It is a discovery version of CLASSIFY, the rationale being that a task requirement to induce a concept from examples might aid in the development and memory for the critical attributes.

The WORD LINE module will teach the target word in the context of other words of the same form class in such a way that the context words plus the target word can be arranged along a

perceptual, affective, or semantic continuum. The roots of the rationale for this module are found in Miller and Johnson-Laird's (1976) notions of semantic domain and in Klein and Saltz's (1976) conceptions that there are semantic dimensions along which words can be arranged or rated. Figure 7 presents some sample word lines.

The EQUIVALENTS module will be a very simple comparison module. Its teaching sequence will contain repeated practice on the correct response contained on our multiple-choice synonym pretest. This module is included in our series of instructional methods to determine whether more complex information structures such as those found in our other six modules are really necessary to support good performance on our criterion tests, or whether simpler types of content, such as that found in this module, might possibly suffice.

These then are our seven instructional modules. Now, for the moment that is left, let's view the experiments procedurally. We are still in the instructional design phase of our research, but this is how we foresee that the experiments will likely run: There are 154 word concepts in our instructional database. College student volunteers at the Learning Skills Center at our university will be the subjects. The subjects will be pre-familiarized with the conventions of using the DECscope video terminal devices as they are connected to our Digital Equipment Corporation PDP-15 computer equipped with a medium-scale time-sharing system. (Incidentally, our research has been assigned

a high enough priority in the time-sharing system that there should be relatively little waiting time for the subjects as their stimuli are printed and responses processed by the PDP-15). In general, the plan for each segment of vocabulary instruction is that on the first day, subjects sign onto the CAI system and take the multiple-choice synonym pretest until they have missed ten words. The pretest items are constructed from the 154 words in our database. Then subjects will receive instruction on the words that were missed. Depending upon which experiment is in progress, they will either receive instruction from only one of the modules, from a combination of all seven modules, or from some other subset of the seven modules. They will return after an interim of one day to take an interim posttest with automatic reteaching of words missed. Following another day's absence, they will return for a final session to take the battery of criterion tests. In the next segment of instruction, the pretest will continue until ten more words are missed. Instruction and testing will then proceed in the manner just described. This cycle will continue until the words on the pretest are exhausted. We also plan to add a standardized verbal ability test to the experimental design in order to determine post hoc whether there is an interaction of ability with method reflected in the relative sizes of direct and indirect instructional effects.

In summary, we are expecting with computer instrumentation that there will be both specific methods effects and indirect

methods effects in our program of vocabulary instruction. What we want to demonstrate is that instruction can be more efficient than we currently think, because a subset of modules is all that is needed for a task that we thought would require a set matched to each criterion test. We are presently in the first stage of our research in which we are calibrating the size of the direct and indirect effects; later stages will require studying how the combined use of the methods confirms or disconfirms our decision theory equations. In addition to improving the quality of instructional theory that teachers are taught, we hope to generate new ideas for vocabulary instruction through the types of techniques that we have developed in this research and development effort.

References

Block, K. K., & McCaslin, E. S. Efficiency in teaching vocabulary concepts: Attainable or not? Unpublished manuscript, 1978. (Available from the authors, Learning Research and Development Center, University of Pittsburgh).

Frase, L. T. Prose processing. In G. H. Bower (Ed.), The psychology of learning and motivation (Vol. 9). New York: Academic Press, 1975.

Gagné, R. M. The conditions of learning (3rd ed.). New York: Holt, Rinehart, & Winston, 1977.

Gagné, R. M., & Briggs, L. J. Principles of instructional design. New York: Holt, Rinehart, & Winston, 1974.

Johnson, D. M., & Stratton, R. P. Evaluation of five methods of teaching concepts. Journal of Educational Psychology, 1966, 57, 48-53.

Klausmeier, H. J., Ghatala, E. S., & Frayer, D. A. Conceptual learning and development: A cognitive view. New York: Academic Press, 1974.

Klein, K., & Saltz, E. Specifying the mechanisms in a levels-of-processing approach to memory. Journal of Experimental Psychology: Human Learning and Memory, 1976, 2, 671-679.

Merrill, M. D., & Tennyson, R. D. Teaching Concepts: An instructional design guide. Englewood Cliffs, New Jersey: Educational Technology Publications, 1977.

Merrill, M. D., & Wood, N. D. Rules for effective instructional strategies (Courseware Instructional Design Series). Orem, Utah: Courseware, Inc., 1975.

Miller, G. A., & Johnson-Laird, P. N. Language and perception. Cambridge: Harvard University Press, 1976.

Rumelhart, D. E., Lindsay, P. H., & Norman, D. A. A process model of long-term memory. In E. Tulving & W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.

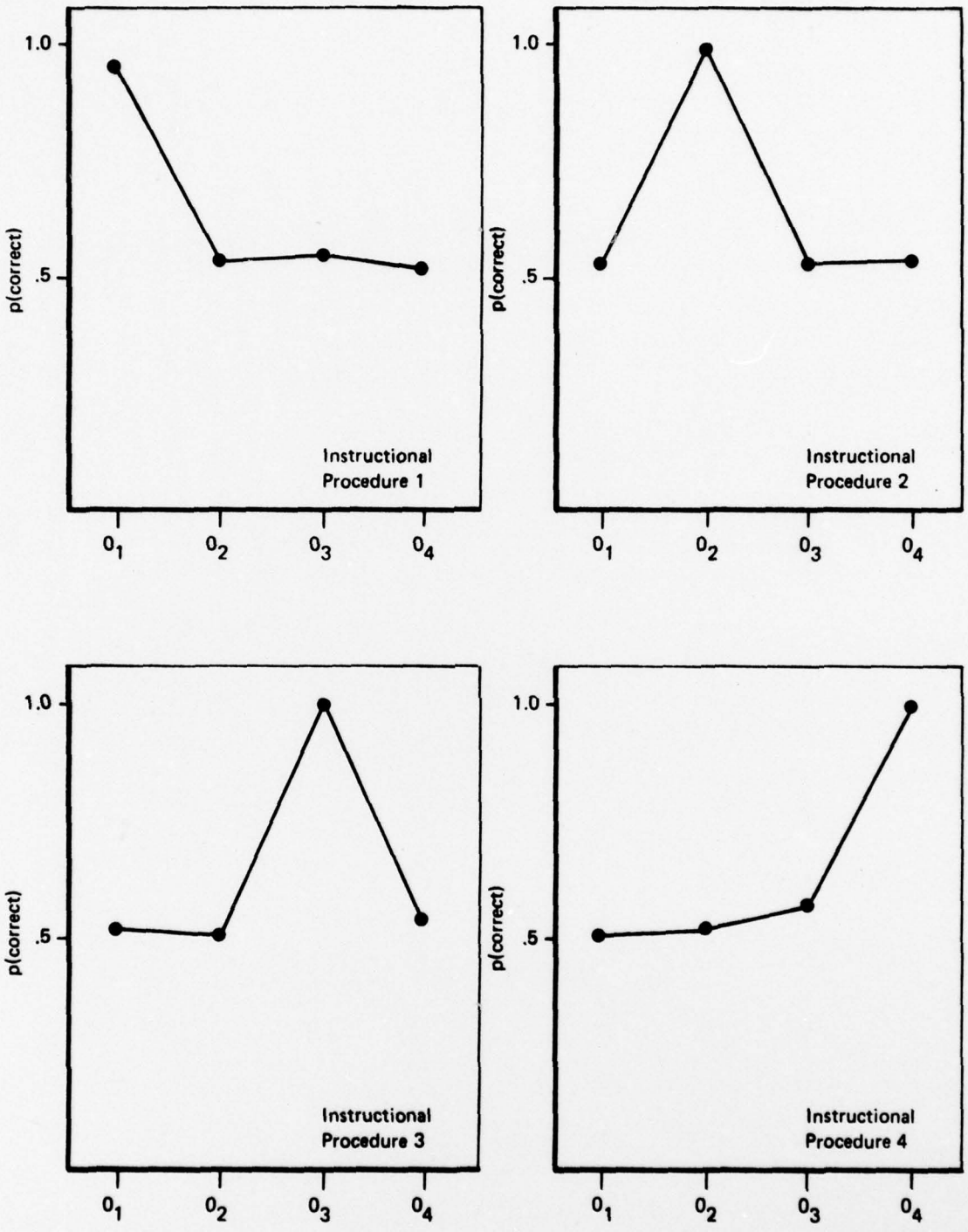

Figure 1. Hypothetical results of vocabulary instruction from current design theory perspective.

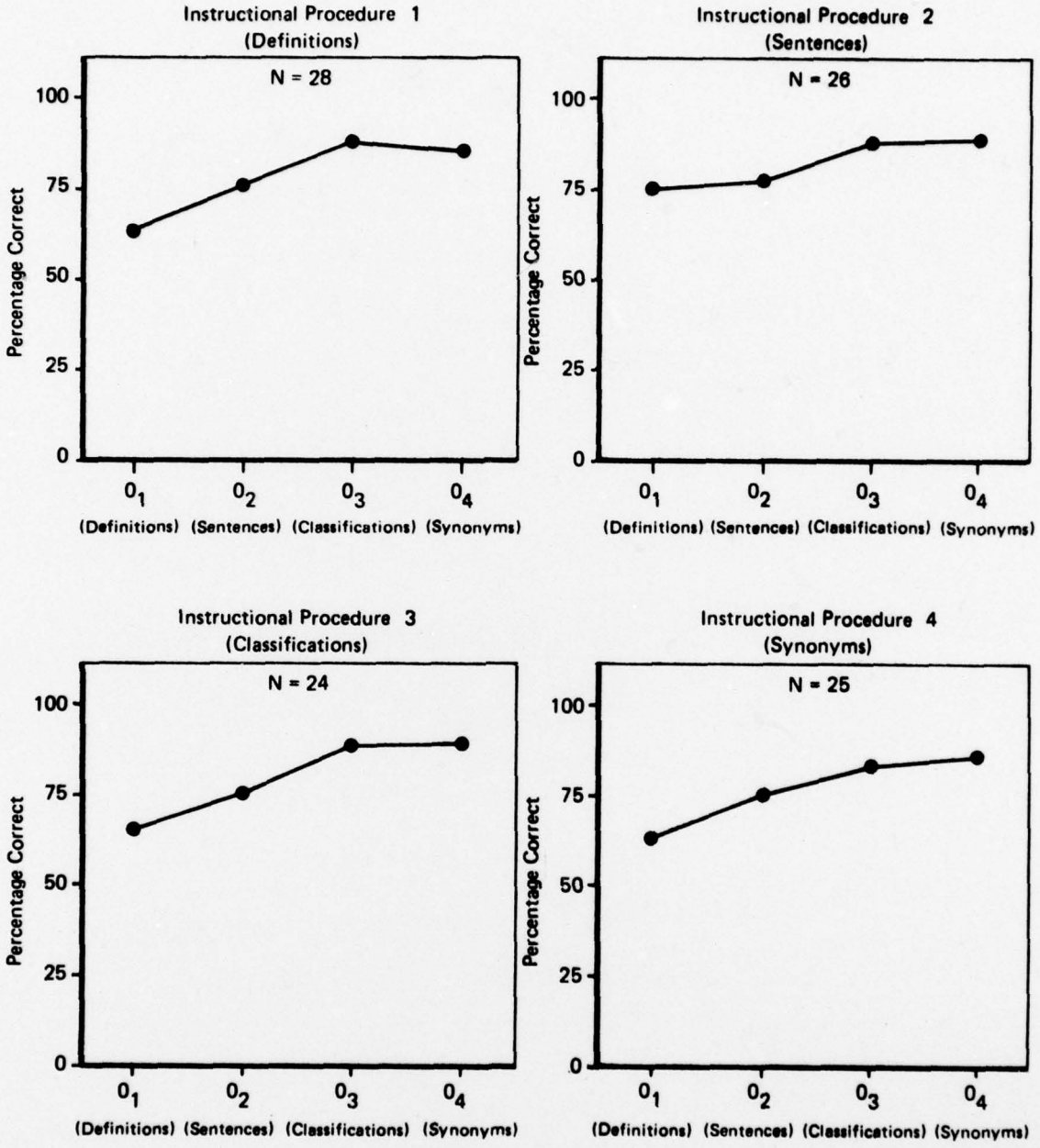

Figure 2. Results of Johnson and Stratton 1966 study of vocabulary concept acquisition.

1. Stating a definition of the target word; (DEFINE).

2. Identifying the semantic relationships that exist between the target word and related concepts; (WORD RELATIONS).

3. Differentiating between examples and non-examples of the target word; (CLASSIFY).

4. Completing sentences meaningfully using the target word; (WORDS IN CONTEXT).

5. Constructing new examples of the concept represented by the target word; (CREATE).

6. Creating lexical structures such as continua within which the target word is located; (WORD LINE).

7. Selecting a synonym of the target word from a set of distractors; (EQUIVALENTS).

Figure 3. Seven performance outcomes associated with word knowledge.

Routine 1: Pronounce

The word is sycophant.

Say the word: SIK eh fant

>

Routine 2: Definition

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by soft-soaping is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person

who tries to get ahead

by buttering up influential people.

>

Figure 4. Simulated DECscope screen displays for DEFINE routines using the target word *sycophant.*

Routine 3: Type word from memory

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by soft-soaping is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person
who tries to get ahead
by buttering up influential people.

Study the new word.

Press return when you are ready to spell it from memory.>

(Only the first screen display of this routine is presented.)

Routine 4: Definition with attribute labeling

Sycophant is a noun.
A noun definition states: a general class of things plus some special qualities.

A sycophant is: a person (GENERAL CLASS)
who tries to get ahead (SPECIAL QUALITY 1)
by buttering up influential people. (SPECIAL QUALITY 2)

Press return to answer questions.>

Figure 4. (Continued)

Routine 5: Multiple choice paraphrase of each of the definition's critical attributes

Pick the phrase that correctly restates
part of the definition.

A sycophant is: anyone
who tries to (**??**)
by apple-polishing people in control.

1) improve his or her position in life
2) help other people
3) hurt his or her friends

Type its number.>

(Only the first screen display of this routine is presented. An option on this routine is to continue the definition presentation from Routine 4.)

Routine 6: Multiple choice paraphrase of all critical attributes

A sycophant is (GEN CLASS) who tries to (SPEC QUAL 1) by (SPEC QUAL 2).

SOMEONE	HARM HIS FRIENDS	PRAISING POWERFUL PEOPLE
ANYTHING	BE HELPFUL	WORKING HARD
ANYONE OR ANYTHING	BECOME SUCCESSFUL	BORROWING

Complete the definition by typing the
correct key terms. Press return after
each key term.

A sycophant is >

(Only the first screen display of this routine is presented.)

Figure 4. (Continued)

Routine 7: Definition construction

Type a definition of sycophant.
Start by typing the word, then identify
its GENERAL CLASS and SPECIAL QUALITIES.

Press return at the end of each line and
again when you have finished.

Check your definition by comparing it
to this one:

> A sycophant is a person who tries to get ahead by buttering up
> influential people.

Note that SYCOPHANT has a general class and two special qualities.

Press return for the next word.>

(~= subject's response. This screen display is the final display of the routine.)

Figure 4. (Continued)

Routine 1: Pronounce

The word is sycophant.

Say the word: SIK eh fant

>

Routine 2: Definition

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by soft-soaping is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person

who tries to get ahead

by buttering up influential people.

>

Figure 5. Simulated DECscope screen displays for the WORD RELATIONS routines using the target word *sycophant*.

Routine 3: *Forced paraphrase*

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by soft-soaping is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person
who tries to get ahead
by buttering up influential people.

One of these phrases captures the meaning of sycophant.

a) a hard-working achiever b) a fast-talking apple-polisher c) a wealthy fat person

Type its letter: >

Routine 4: Type word from memory

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by soft-soaping is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person
who tries to get ahead
by buttering up influential people.

Study the new word.

Press return when you are ready to spell it from memory.>

(Only the first screen display of this routine is presented.)

Figure 5. (Continued)

Routine 5: Explanation of relations

Words can be related to each other in
various ways:

For example, if helpfulness is a QUALITY of a Boy Scout,
then insincerity is a QUALITY of a sycophant.

Type in the correct answer to this statement:

Ambition could also be a (**??**) of a sycophant. >

(Only the first screen display of the routine is presented.)

Routine 6: Practice relations

Identify this relationship by typing the correct letter: >

1. How is dishonesty related to a sycophant?
   a) is SIMILAR to b) is a QUALITY of c) is a TIME of

(Only the first screen display of the routine is presented.)

Figure 5. (Continued)

Routine 1: Pronounce

The word is sycophant.

Say the word: SIK eh fant

>

Routine 2: Definition

Read the definition:

Sometimes, you may meet a person who attempts to win favor or advancement by flattering persons of influence. This kind of person who wants to get ahead by *soft-soaping* is called a SYCOPHANT.

Thus, a SYCOPHANT is: a person

who tries to get ahead

by buttering up influential people.

>

Figure 6. Simulated DECscope screen displays for the CLASSIFY routines using the target word *sycophant*.

Routine 3: Matched examples and nonexamples

This is an EXAMPLE of a sycophant:

a starlet buttering up a well-known film director in order to get a leading role

This is NOT AN EXAMPLE of a sycophant:

a starlet dating a film director because she likes him

Refer to the NONEXAMPLE. Type Y or N to answer this question:

Is the starlet in the NONEXAMPLE buttering up the director in order to get ahead?

Type your answer here: >

(Only the second major screen display of the routine is presented.)

Routine 4: Forced choice of example

One of the instances below is an example of a sycophant.
The other is not. Type the number of the instance that
is the EXAMPLE of a sycophant.

1) an applicant at a country club trying to become a member by filling out the application form and dropping it off at the club

2) an applicant at a country club trying to become a member by currying favor with the club's membership director

Type your answer here: >

(Only the first screen display of the routine is presented.)

Figure 6. (Continued)

Routine 5: Classification

If this instance is an example of a sycophant, type the word: SYCOPHANT.
If it is not an example of sycophant, type: NOT A SYCOPHANT.

a second-string football player apple-polishing the coaches
in order to get a starting position on the team

Type your answer here: >

(Only the first screen display of the routine is presented.)

Figure 6. (Continued)

Target Word 1: SYCOPHANT (noun)

evil — good

Words to arrange on the line: murderer, child-molester, drug pusher, thief, braggart, sycophant, complainer, average Joe, humanitarian, missionary, saint

Possible instances to be rated along the line:

1. a law-abiding citizen
2. a drunk
3. Adolf Hitler
4. an apple-polisher
5. a Peace Corps volunteer
6. Albert Schweitzer

Target Word 2: ARTICULATE *(verb)*

difficult-to-understand speech — easy-to-understand speech

Words to arrange on the line: garble, slur, mutter, mumble, whisper, talk, pronounce, articulate, enunciate

Possible instances to be rated along the line:

1. a heavily-accented voice
2. an elementary school teacher's voice
3. a voice on a heavily-overloaded telephone line
4. an actor's stage voice
5. a normal conversational voice
6. the voice of a politician who is trying to make a point

Figure 7. Sample word lines.